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NATIONAL STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

中华人民共和国国家标准

GB 175-2007

Replace GB 175-1999, GB 1344-1999, GB 12958-1999

Common Portland Cements

通用硅酸盐水泥

(2009 Edition)

Issued on November 9, 2007 Implemented on June 1, 2008

Jointly issued by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) of and CNS Management Committee (CNSMC) the People's Republic of China

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No.1 Amendment of GB 175-2007 Common Portland Cements

This amendment is approved by the Standardization Administration of China on June 12, 2009 and will be implemented on September 1, 2009.

1. Delete "JC/T420 Chemical analysis method of chloride in cement materials" from "2 Normative References".
2. "8.4 Chloride ion: The test should be carried out according to JC/T 420." is changed into "8.4 Chloride ion: The test should be carried out according to GB/T 176."

Standardization Administration of China
June 18, 2009

Foreword

Articles of 7.1, 7.3.1, 7.3.2, 7.3.3 and 9.4 in this national standard are obligatory clauses and the rest are commendatory clauses.

This national standard is non-equifinal to European cement standard EN 197-1:2000.

This standard will replace the three Standards from the date of its implementation: *GB175-1999 Portland Cements and Ordinary Portland Cement, GB1344-1999 Slag Portland Cement, Portland-pozzolana cement, Fly-ash Portland Cement, GB12958-1999 Composite Portland Cement.*

Compared with GB175-1999, GB1344-1999 and GB12958-1999, this national standard has the following changes:

- Full-text obligatory clauses are changed to provisional obligatory clauses (Foreword of this edition).
- Add definition for common Portland cement (Chapter 3 in this Edition).
- Cancel cements' definition for all kinds (Chapter 3 in original editions of GB175-1999, GB1344-1999, GB12958-1999)
- Combine Composition and Materials into one chapter (Chapter 4 in original editions of GB175-1999, GB1344-1999, GB12958-1999)
- For ordinary Portland cement, "when active admixture was mixed in, the maximum mixed amount should not exceed 15% and it is permitted to use kiln ash no more than 5% of the cement's mass and non-active admixture no more than 10% of the cement's mass instead" is changed into "mixed active admixture >5%, ≤20%, and it is permitted to use kiln ash(in compliance with Article 5.2.5) no more than 5% of the cement's mass and non-active admixture(in compliance with Article 5.2.4) no more than 8% of the cement's mass instead"(Article 3.2 in Original edition of GB175-1999, Article 5.1 in this edition).
- Slag content in slag Portland cement is changed from "20%~70%" into ">20%, ≤70%"and is classified as Type A and Type B. Type A's mixed slag >20%, ≤50%, code number is P.S.A; Type B's mixed slag>50%, ≤70% (Article 3.1 in original edition GB1344-1999, Article 5.1 in this edition;)
- Volcanic ash content in Portland-Pozzolana cement is changed from "20%~50%" into ">20%, ≤40%" (Article 3.2 in original edition GB1344-1999, Article 5.1 in this edition;)
- Mixed substances in composite Portland cement change from "greater than 15% but no greater than 50%" into ">20%, ≤50%" (Chapter 3.3 in original edition GB12598-1999, Article 5.1 in this edition;)
- Add granulated blast-furnace slag powder in the materials (Article 5.2.3 and Article 5.2.4)

- Cancel granulated chrome iron slag, granulated-calcium enhanced liquid slag, granulated carbon chrome iron slag, granulated blast furnace slag bearing titania and other admixture, and newly developed mixed materials compliable with Annex A; cancel Annex A (Article 4.2 and Article 4.3 and Annex A in original edition of GB12958-1999)
- Add M-type mixed gypsum and cancel A-type hard gypsum (Chapter 3 in GB175-1999, GB1344-1999 and GB12958-1999, Article 5.2.1.1 in this edition).
- Mixed grinding aids change from "no greater than 1% of the mass of cement" into "no greater than 0.5% of the mass of cement" (Article 4.5 in original editions GB175-1999, GB1344-1999 and GB12958-1999, Article 5.2.6 in this edition);
- Cancel 32.5 and 32.5R for ordinary cement's strength level (Chapter 5 in original edition GB175-1999 and Chapter 6 in this edition);
- Change "the magnesium oxide content in clinkers" of slag Portland cement, Portland-Pozzolana cement, Fly-ash Portland cement and composite Portland cement to "the magnesium content in cement". For types P.S.A, P.P, P.F, and P.C, magnesium contents should be no greater than 6.0% and a note should be given that "if magnesium content in cement is greater than 6.0%, this kind of cement should pass the autoclave test and is proved be qualified"; no requirement for P.S.B. (Article 6.1 in the original editions GB1344-1999 and GB 12598-1999, Article 7.1 in this edition)
- Add the content limit of Chloride ion and Chloride ion's content should be no greater than 0.06% (Article 7.1 in this edition);
- Change the strength indicators of ordinary Portland cement of all strength levels to make them identical to those of the Portland cement; change the strength indicators of composite Portland cements of all strength levels to make them identical to those of the slag Portland cement, Portland-Pozzolana cement, Fly-ash Portland cement (Article 6.6 in original edition GB12958-1999, 7.3.3 in this edition)
- 45 μm Square-hole sieve residue no greater than 30% will be taken as an indicator (Article 7.3.4 in this edition);
- Add rules and regular verification for cement composition test method.
- Expand the applicable scope of the regulation "decide the water amount according to 0.05 water-cement ratio and mortar mobility no less than 180 mm" from regulated cement types to Portland-Pozzolana cement, Fly-ash Portland cement, composite Portland cement and ordinary Portland cement mixed with volcanic ash content (Article 7.5 in original edition GB 1344-1999 and Article 8.5 in this edition)
- Add serial number and sample for annual capacity "over 200x104 t", that is: greater than 200x104 t but no greater than 4000 t as a serial number; change "greater than 1200,000 tons no greater than 1200 tons as a serial number" to "120x104 t~ 200x104, no greater than 2400 t as a serial number" (Article 8.1 in original editions GB175-1999,GB1344-1999,GB12958-1999, Article 9.1 in this edition)
- Change "Finished cement's strength level should be guaranteed, other technical specifications should comply with related specifications of this national standard" into "cement can be shipped only when all cement's technical indicators and packaging quality comply with requirements" (Article 8.2 in original editions GB175-1999,GB1344-1999,GB12958-1999, Article 9.2 in this edition).

- Add factory inspection (Article 9.3 in this edition).
- Cancel the rejected product testing (Article 8.3.1 in original edition GB175-1999,GB1344-1999,GB12958-1999);
- Cancel the regulations for the fineness and mixed amount of admixture in unacceptable products. The test rule changes into "according to the test result, if the products comply with 7.1, 7.3,.1, 7.3.2, 7.3.3, then it is rated as acceptable products; if the products fail to comply with 7.1, 7.3.1, 7.3.2, 7.3.3, then it is rated as unacceptable products". (Article 8.3.2 in original editions GB175-1999, GB1344-1999, GB12958-1999, Article 9.4.1 and 9.4.2 in this edition).
- In inspection report, add "other technical specifications by the contract" (Article 8.4 in original editions GB175-1999, GB1344-1999, GB12958-1999, Article 9.5 in this edition.)
- In delivery and acceptance report, add "soundness arbitration should be finished within ten days of its sampling."(Article 9.6.2 in this edition)"
- As for the package marking, "Both sides of Portland-Pozzolana cement, Fly-ash Portland cement and composite Portland cement should be printed in black" changes into "Both sides of Portland-Pozzolana cement, Fly-ash Portland cement and composite Portland cement should be printed in black or blue (Article 9.2 in original editions GB175-1999, GB1344-1999, GB12958-1999, Article 10.2 in this edition).

This national standard is proposed by China Building Materials Industry Association.
This national standard is under the jurisdiction of Technological Standard Committee for Cement (SAC/TC184).
Primary unit drafting organization: China Building Materials Academy
Units that have taken part in the drafting: Tangshan Jidong cement holding co., Ltd., Fujian cement holding Co., ltd., Shandong Conglin Corporation, Dujiangyan Lafaji Co., Ltd., Yunan Guozi Cement Honghe Co., Ltd.,Yun'nan Guozi Cement Kunming Co., Ltd., Hefei Cement Designing Institute, Guangdong Architecture Science Institute, Shandong Cement Quality Supervision and Inspection Center, Shanghai Building Scicence Institute Co., ltd., Building Materials Industrial Technological Intelligence Rearch Center, GuanLu Corporation Shandong Wanli Cement Co., Ltd., and Tangshan Longfeng Cement Co., Ltd.
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This national standard shall replace the following historical editions
- GB175-1956, GB175-1962, GB175-1977, GB175-1985, GB175-1992, GB175-1999;
- GB1344-1956, GB1344-1962, GB1344-1977, GB1344-1985, GB1344-1992, GB1344-1999;
- GB12958-1981, GB12958-1991, GB12958-1999.

Common Portland Cements

1 Scope

This national standard specifies that common Portland cements' compositions, materials specifications, strength levels, technical specifications, test methods, test rules, packaging, marking, transportation, storage, and so on.

This national standard is applicable to common Portland cements.

2 Normative Reference

The following normative documents contain provisions which, through reference in this text, constitute provisions of this national standard. For dated reference, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

GB/T176 Chemical analysis method of cement (GB/T176-1996, eqv ISO680:1990)
GB/T203 Granulated slag ash used for cement
GB/T750 Autoclave method for soundness of cement
GB/T1345 Fineness test method for cement (sieve processing method)
GB/T1346 Water amount for standard testing consistency, setting time and test method for the soundness of cement (GB/T1346-2001, eqv ISO9597:1989)
GB/T1596 Fly-ash used for cement and concrete
GB/T2419 Test method for cement mortar mobility
GB/T2847 Volcanic ash admixture
GB/T5483 Gypsum and hard gypsum
GB/T8074 Cement's specific surface area test method (Blaine)
GB9774 Package bag of cement
GB12573 Cement's sampling
GB/T12960 Examination of cement's composition of certain amount
CB/T17671 Test method for the cement mortar's strength level (ISO method) (GB/T17671-1999, idt ISO679:1989)
GB/T18046 Granulated blast-furnace slag powder used in cement and concrete
JC/T667 Cement's grinding aids
JC/T742 Rotary Kiln ash blended in cement

3 Terms and Definitions

The following terms and definitions are applicable to this national standard.
Common Portland cement:
It is a kind of cement matrix composed of Portland cement clinkers and appropriate gypsum, plus specified admixture.

4 Classifications

Common Portland cement specified in this national standard include Portland cement, ordinary Portland cement, slag Portland cement, Portland-Pozzolana cement, Fly-ash Portland cement and composite Portland cement. Compositions and codes of all kinds should comply with specifications in Article 5.1.

5 Composition and Material

5.1 Composition

Compositions of common Portland cement should comply with specifications of Table 1.

Table 1 %

Type	Code number	Composition (mass fraction)				
		Clinker + Gypsum	Granulated blast-furnace slag	Volcanic ash admixture	fly ash	Limestone
Portland Cement	P.I	100	-	-	-	-
	P.II	≥95	≤5	-	-	-
		≥95	-	-	-	≤5
Ordinary Portland Cement	P.O	≥80, <95	>5, ≤20[a]			-
Slag Portland Cement	P.S.A	≥50, <80	>20, ≤50[b]	-	-	-
	P.S.B	≥30, <50	>50, ≤70[b]	-	-	-
Portland-Pozzolana Cement	P.P	≥60, <80	-	>20, ≤40[c]	-	-
Fly-ash Portland cement	P.F	≥60, <80	-	-	>20, ≤40[d]	-

Composite Portland Cement	P.C	≥50, <80	>20, ≤50[e]
Materials of the composition refer to active admixture in compliance with Article 5.2.3 of this national standard. The materials are permitted to be replaced by non-active admixture in compliance with Article 5.2.4 of this national standard with its mass no greater than 8% of the cement's or kiln ash in compliance with Article 5.2.5 of this national standard no greater than 5% of the cement's mass. Materials of the composition refer to active admixture in compliance with GB/T 203 or GB/T 18046.The materials are permitted to be replaced by active admixture in compliance with Article 5.2.3 of this national standard with its mass no greater than 8% of the cement's or non-active admixture in compliance with Article 5.2.4 or kiln ash in compliance with Article 5.2.5 of this national standard no greater than 5% of the cement. Materials of the composition refer to active admixture in compliance with GB/T 2847. Materials of the composition refer to active admixture in compliance with GB/T 1596. Materials of the composition are composed of two plus kinds of active admixture in compliance with Article 5.2.3 of this national standard or/and non-active admixture in compliance with Article 5.2.4 of this national standard. It is permitted to replace the admixture with kiln ash in compliance with Article 5.2.5 of this national standard no greater than 8% of the cement's mass. If it is mixed with slag, the mixed admixture should not be identical with that of Slag Portland Cement.			

5.2 Materials

5.2.1 Cement clinker of Portland cement

Materials are mainly composed of CaO, SiO2, Al2O3 and Fe2O3. According to a proper proportion, they are grinded into fine powders, burned until partially fused and the hydraulic refractory gelatinous substance is obtained with its main composition calcium silicate. Mineral substance of calcium silicate should be no less than 66%. Mass ratio of Calcium oxide and silicon oxide should be no less than 2.0.

5.2.2 Gypsum

Natural gypsum:
It should be gypsum or mixed gypsum higher than Class 2 (including Class 2) of Classification G, Classification M, and Classification A specified in GB/T 5483.
Industrial by-product Gypsum:
By-product from industrial production is mainly composed of calcium sulfate. Before the industrial by-product gypsum is put in use, it should be tested and proved to be harmless to the cement's property.

5.2.3 Active admixture

The admixture should be granulated blast-furnace slag, granulated blast-furnace slag powder,

fly-ash and volcanic ash content in compliance with GB/T203, GB/T18046, GB/T1596 and GB/T2847.

5.2.4 Non-active admixture

Admixture composed of granulated blast-furnace slag, granulated blast-furnace slag powder, fly-ash and volcanic ash content with its activity indicator lower than the standard specified in GB/T203, GB/T18046, GB/T1596 and GB/T2847; limestone, sandstone and limestone alumina content should be no greater than 2.5%.

5.2.5 Kiln ash

It should comply with specifications of JC/T742.

5.2.6 Grinding aids

Grinding aids are permitted to be added when the cement is powdered but the added amount should be no greater than 0.5% of the cement's mass and the grinding aids should be in compliance with specifications in JC/T667.

6 Strength Level

6.1 Strength levels of Portland cement: 42.5, 42.5R, 52.5, 52.5R, 62.5, 62.5R six levels.
6.2 Strength levels of ordinary cement: 42.5, 42.5R, 52.5, 52.5R four levels
6.3 Strength levels for slag, volcanic ash, fly-ash and composite cement are classified as 32.5, 32.5R, 42.5, 42.5R, 52.5 and 52.5R six levels.

7 Technical Specifications

7.1 Chemical Indicators

Chemical indicators should comply with specifications in Table 2.

Table 2 %

Type	Code number	Insoluble substance (mass fraction)	Loss on ignition (mass fraction)	Sulfur trioxide (mass fraction)	Magnesium oxide(mass fraction)	Chloride ion (mass fraction)
Portland Cement	P.I	≤0.75	≤3.0	≤3.5	≤5.0a	≤0.06C
	P.II	≤1.50	≤3.5			
Ordinary Portland Cement	P.O	-	≤5.0			

Slag Portland Cement	P.S.A	-	-	≤4.0	≤6.0b	
	P.S.B	-	-		-	
Portland-Pozzolana Cement	P.P	-	-	≤3.5	≤6.0b	
Fly-ash Portland cement	P.F	-	-			
Composite Portland Cement	P.C	-	-			

a. If the cement is proved to be qualified in the autoclave method test for soundness, the magnesium oxide content (mass fraction) is permitted to be extended to 6.0%.

b. If the magnesium oxide content (mass fraction) in cement is greater than 6.0%, the cement should be required for autoclave method test for soundness and proved to be qualified.

c. When even lower proportion is demanded, the index for it should be negotiated by Buyer and Seller.

7.2 Alkali content

Alkali content should be calculated according to Na2O+0.658K2O. If active aggregate is used, and the client asks for low-alkali cement, the alkali content should be no greater than 0.60% or negotiated by Supplier and Buyer.

7.3 Physical requirement

7.3.1 Setting time

Portland cement's initial setting should happen within 45 minutes and its final setting should take place in no longer than 390 min. Initial setting time of ordinary Portland cement, slag Portland cement, Portland-Pozzolana Cement, fly-ash Portland Cement, and composite Portland cement should be no shorter than 45min and the final setting time should be no longer than 600 min.

7.3.2 Soundness

Soundness qualification should be proved by the boiling checking method.

7.3.3 Strength level

Strength of Portland cements of different classifications and different strength levels at different ages should comply with specifications in Table 3.

Table 3 Unit as MPa

Classification	Strength level	compressive strength		flexural strength	
		3d	28d	3d	28d
Portland Cement	42.5	≥17.0	≥42.5	≥3.5	≥6.5
	42.5R	≥22.0		≥4.0	
	52.5	≥23.0	≥52.5	≥4.0	≥7.0
	52.5R	≥27.0		≥5.0	
	62.5	≥28.0	≥62.5	≥5.0	≥8.0
	62.5R	≥32.0		≥5.5	
Ordinary Portland Cement	42.5	≥17.0	≥42.5	≥3.5	≥6.5
	42.5R	≥22.0		≥4.0	
	52.5	≥23.0	≥52.5	≥4.0	≥7.0
	52.5R	≥27.0		≥5.0	
Slag Portland cement	32.5	≥10.0	≥32.5	≥2.5	≥5.5
	32.5R	≥15.0		≥3.5	
Portland-Pozzolana Cement	42.5	≥15.0	≥42.5	≥3.5	≥6.5
	42.5R	≥19.0		≥4.0	
fly-ash Portland Cement	52.5	≥21.0	≥52.5	≥4.0	≥7.0
	52.5R	≥23.0		≥4.5	
Composite Portland cement					

7.3.4 Fineness (selective indicator)

Fineness of Portland cement and ordinary Portland cement should be expressed by specific surface and the fineness should be no less than 300m2/kg; fineness of slag Portland cement, Portland-Pozzolana Cement, fly-ash Portland Cement and Composite Portland cement should be expressed by sieve residue. For 80 μm square-hole sieve, sieve residue should be no greater than 10% and for 45 μm square-hole sieve, sieve residue should be no greater than 30%.

8 Test Method

8.1 Composition

The manufacturer should make products according to GB/T12960. Under normal manufacturing conditions, the manufacturer should check the composition of cement at least once per month and its annual average should comply with specifications of Article 5.1 in this national standard. Each single result should be no greater than 2% of the permitted maximum.

To ensure the accurateness of the composition test result, manufacturer should adopt proper manufacturing process and appropriate test method to ensure the reliability of the selected method and make the test method into documents.

8.2 Insoluble substance, loss on ignition, magnesium oxide, sulfur trioxide and alkali content

The test should be carried out according to GB/T 176.

8.3 Autoclave method for soundness

The test should be carried out according to GB/T 750.

8.4 Chloride ion

The test should be carried out according to GB/T 176.

8.5 Water requirement of normal consistency, setting time and soundness of the portland cements

The test should be carried out according to GB/T 1346.

8.6 Strength level

The test should be carried out according to GB/T17671. When Portland-Pozzolana cement, fly-ash Portland cement, composite Portland cement and ordinary Portland cement mixed with volcanic ash are tested for their mortar's strength, the water amount used should be decided according to 0.50 water-cement ratio and mortar mobility no lower than 180mm. When the mobility is lower than 18mm, water-cement ratio should be adjusted through integral multiple ascending by 0.01 until its mortar's mobility is no lower than 180mm.
Mortar mobility test should comply with GB/T2419 and the mortar's making should comply with GB/T17671.

8.7 Specific surface

The test should be carried out according to GB/T8074.

8.8 80 μm and 45 μm sieve residue

The test should be carried out according to GB/T1345.

9. Test Rules

9.1 Serial number and sampling

Before being transported out of factory, cement should be given a serial number and sampled according to classifications and strength levels. Bagged cement and bulk cement should be

given serial number and sampled respectively. Each serial number is a sampling unit. Cement's factory serial number should be specified according to its annual output of a single producing line:
Over 200x104t, no greater than 4000t as a serial number;
120x104t~ 200x104t, no greater than 2400t as a serial number;
60x104t~ 120x104t, no greater than 1000t as a serial number;
30x104t~ 60x104t, no greater than 600t as a serial number;
10x104t~ 30x104t, no greater than 400t as a serial number;
Less than 10x104t, no greater than 200t as a serial number;

Sampling method should comply with GB12573. The sampling can be made consecutively or be adopted from 20 plus different parts with the same amount and the total amount should be at least 12kg. When capacity of transportation tools for cement in bulk exceeds the tonnage specified by the factory, it is permitted that the serial number's amount exceeds the specified tonnage.

9.2 Cement's being delivered out of factory

After being confirmed that the cement's each technical indicator as well as its packaging quality meets the requirements, the cement can be delivered out of factory.

9.3 Factory inspection

Factory inspection includes articles of 7.1, 7.3.1, 7.3.2, and 7.3.3.

9.4 Criterion rule

9.4.1 Cement will be considered to be qualified if factory inspection result meets specifications of 7.1, 7.3.1, 7.3.2 and 7.3.3 of this national standard.
9.4.2 Cement will be considered as unacceptable product if its inspection result fails to comply with any technical specifications of 7.1, 7.3.1, 7.3.2 and 7.3.3.

9.5 Inspection report

Inspection report should include all technical specifications and inspection result of the fineness, name of the admixture and the mixed amount, and if the production belongs to rotary kiln production or vertical kiln production. If required by the clients, the manufacturer should deliver the test result of all items except 28d-strength test within seven days on cement's delivery. The result of 28d strength test should be supplemented within 32 days on cement's delivery.

9.6 Delivery and acceptance

Samples will be drawn off from the products for inspection and the result will be referred to on cement's acceptance, and it is also acceptable to take evidence from the inspection report of its same serial number cement produced by the manufacturer. Buyer and Seller should

consult and specify it on the contract or agreement on which method to adopt for its acceptance. Seller has the obligation to teli the buyer about the acceptance method. If there is no written contract or agreement, or the acceptance method is not notified in the contract or agreement, Seller should note on the commercial invoice that "inspection report of the factory's same serial number cement will be taken as acceptance evidence".

If the actual sampling method is taken as the evidence for the acceptance, both vendor and purchaser should sample and seal together before products' shipping or at the place of delivery. The sampling procedure should comply with GB12573 and the sampling amount should be 20kg, which will be divided into two identical parts. One sample will be preserved by Seller for 40 days and the other should be tested by Buyer according to the specified items and methods in this standard.

Within 40 days, if purchaser decides that product quality does not comply with requirements of this national standard after test but the vendor has a different opinion, then both parties should send the other sample kept by the vendor to nationally recognized provincial or higher cement supervision and inspection authorities to arbitrate. Cement's soundness test through arbitration should be finished within 10 days after the sampling is made.

If inspection report of the cement's same serial number is taken as the evidence for acceptance, then before shipping or delivery, both parties should sample from the cement of the same serial number and preserve it for 90d after signing and sealing by both parties; the vendor can also accredit purchaser to sample from the same serial number cement and seal and preserve it for 90d.

If Buyer questions the quality of cement's product, Buyer and Seller should send the mutually admitted sample to cement quality supervision and inspection institution at least provincially admitted for arbitration.

10. Package, Marking, Transportation and Storage

10.1 Package

Cement can be bagged or in bulk. For bagged cements, net weight of each bag of cement should be 50kg and the mass should be no lower than 98% of the marked mass; for each 20 bags randomly drawn off, the total mass (package bags included) should be no less than 1000kg. For other packaging forms, Buyers and Suppliers can negotiate on it; however, mass requirement of bagged cement must comply with the above specifications. Cement's package bags should comply with specifications of GB9774.

10.2 Marking

The package bag of cement should be marked clearly with manufacturer's name, manufacturing license number, name of the cement and its code number, strength level, factory number, voluntary standards number and packaging date. Both sides of the packaging bags should be marked with the name of the cement and its strength level. For Portland cement and ordinary Portland cement, both sides should be printed in red; for slag Portland cement, the marking should be in green; for Portland-Pozzolana Cement, fly-ash

Portland cement and composite Portland cement, the markings should be in black or blue. When the cements are transported in bulk, cards with the same contents as those on the cards of the bagged cements should be submitted.

10.3 Transportation and storage

During transportation and storage, cement cannot be stamped or interfused with sundries. Cements of different classifications and different strength levels should be transported and stored respectively and cannot be interfused.